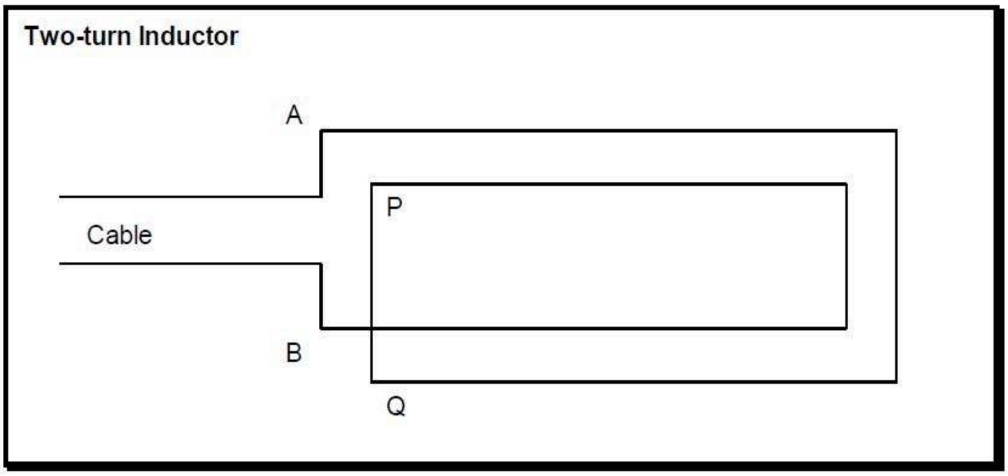
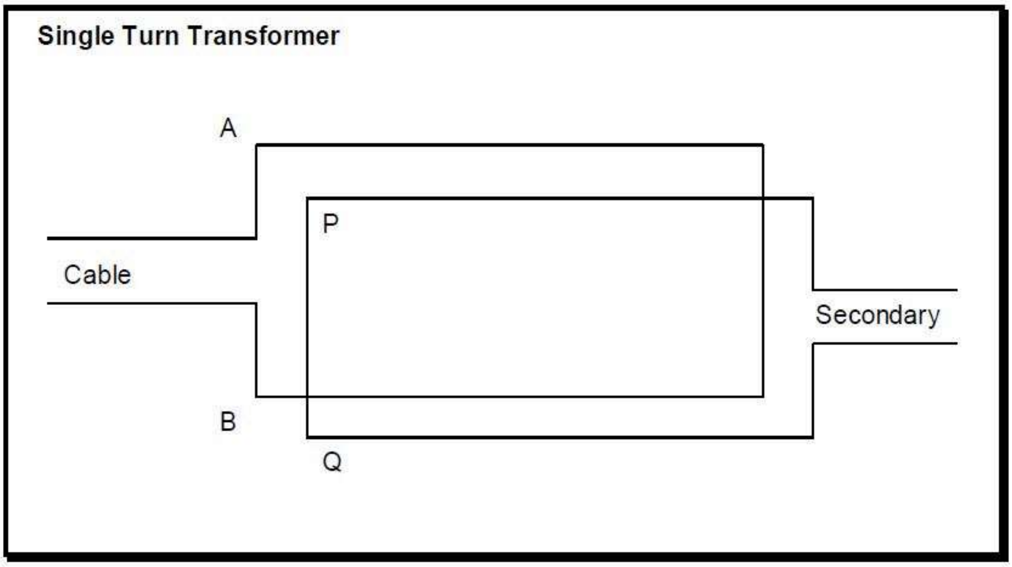
Two Turn Inductor, One Turn Transformer Derivation of Reflection and Transmission Coefficients

By Mike Gibson and Ivor Catt, June 1986





Here is a description of the symbols used in the derivations:

V_{FC} voltage on cable moving towards the inductor
V_{RC} voltage on cable moving away from the inductor

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Z_C characteristic impedance of the cable
V_{FE} voltage traveling in the forward direction in the even mode
V_{FO} voltage traveling in the forward direction in the odd mode
V_{RE} voltage traveling in the reverse direction in the even mode
V_{RO} voltage traveling in the reverse direction in the odd mode
Z_E characteristic impedance of even mode
Z_O characteristic impedance of odd mode
V_{FS} secondary voltage moving away from the transformer
V_{RS} secondary voltage moving towards the transformer

Going from the cable to the inductor, the following basic equations hold,

$$\begin{array}{ll} 1) & V_{FC} + V_{RC} = V_{FE} + V_{FO} = V_{AB} \\ 2) & I_{FC} + I_{RC} = I_{FE} + I_{FO} = I_{AB} \\ 3) & V_{FE} - V_{FO} = V_{PQ} = 0 \end{array}$$

Transforming (2) into voltages gives,

$$4) \qquad \frac{V_{FC}}{Z_C} - \frac{V_{RC}}{Z_C} = \frac{V_{FE}}{Z_E} + \frac{V_{FO}}{Z_O}$$

Multiplying through by Z_C and defining new terms for the resulting ratios yields,

$$5) \qquad V_{FC} - V_{RC} = r_E V_{FE} + r_O V_{FO}$$

$$6) \qquad \boxed{r_E = \frac{Z_C}{Z_E} \qquad r_O = \frac{Z_C}{Z_O}}$$

From (1),

$$7) \qquad V_{RC} = V_{FE} + V_{FO} - V_{FC}$$

Substituting (7) into (5) and gathering terms,

$$7) \qquad V_{FC} - V_{FE} - V_{FO} + V_{FC} = r_E V_{FE} + r_O V_{FO}$$

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